Evaluating the Tectonic and Climatic Controls on Sediment-Hosted Ore Deposits in Deep Time

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Sediment-hosted ore deposits are the world's largest source of the critical mineral cobalt, the second largest source of copper, and an important source of base metals such as lead and zinc. These deposits are essential to supporting the global energy transition, yet the processes that control their formation remain poorly understood.

This study integrates a newly updated global database of sediment-hosted ore deposits with a full-plate tectonic reconstruction spanning the last billion years. By linking the timing and location of known deposits to evolving tectonic settings and paleoclimatic conditions, we aim to quantitatively assess the key environmental and geodynamic criteria that favour ore formation. Using plate reconstruction software and global paleoclimate models, we evaluate paleolatitudes, tectonic regimes, and climate proxies through time to better understand the spatial and temporal patterns of deposit formation. In doing so, we test long-standing assumptions about the relationship between ore formation and subtropical evaporite belts and explore the potential influence of major climate events such as Neoproterozoic glaciations. Preliminary findings suggest that a range of climatic and tectonic factors may influence the formation and preservation of these systems.

We also present new results from numerical analyses that show statistically significant spatial correlations between sediment-hosted deposits and fossil rift margins. These findings support the idea that long-lived extensional settings, and their subsequent reactivation, play a key role in creating favourable conditions for Cu-Co mineralisation.

Together, these results contribute to a new quantitative global framework for understanding where sediment-hosted deposits are most likely to occur. This work has direct implications for identifying underexplored but highly prospective sedimentary basins in Australia and globally, with relevance for critical mineral exploration strategies.